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The digitalization of supply chain: a review

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Abstract

The emergence of new digital technologies as part of Industry 4.0 has enabled the supply chain to be managed more efficiently. We talk about digitalization of the supply chain and this trend refers to the evolution towards a smarter model that involves digital technologies such as Blockchain, IoT, Machine Learning, etc. These technologies actually increase and enhance the ability to optimize planning, sourcing and procurement strategies. Since this topic is of relevant interest for the scientific community, this paper aims to investigate the main discussion themes related to supply chain digitalization using a keyword-based organizing framework to identify, classify and investigate relevant intellectual contributions in this field.. Results showed which are the main issues regarding supply chain digitalization as well as promising future research avenues.

Keywords: supply chain; digitalization; keywords analysis; review

1. Introduction

Today, it is not possible to talk about digital supply chain without connecting to the broader theme of the development of Industry 4.0 [1]. This new paradigm enables the creation of a new ecosystem based on the interconnection of the different functional areas of a company and among different companies. In fact, organizations are reshaping their strategies in order to become increasingly transparent in their business practices, including supply chain management [2]. Digitalization offers great benefits for the supply chain, such as increased availability of information, optimization of logistics practices, real-time data collection, more efficient inventory management and

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increased transparency. In general terms, Industry 4.0 can be defined as the "development of production and value creation systems by linking the real and the digital world" [3]. This linkage is made possible by Cyber-Physical Systems (CPS), considered one of the key technological innovations of the fourth industrial revolution. Different definitions of CPSs exist in the literature, partly due to the different perspectives and applications they may have. A CPS is a set of different enabling technologies that generate an autonomous, intercommunicating and intelligent system and, therefore, capable of facilitating integration between different and physically distant actors. This system enables three sequential scenarios: data generation and acquisition, computation and aggregation of previously acquired data, and, finally, decision-making support [4]. Using these technologies, companies operating in the supply chain are able to make a digital transformation that allows them to improve performance and maintain or increase competitiveness [3]. Since the topic of supply chain digitalization has been gaining momentum in recent years within the scientific community, it is interesting to focus on the main areas of interest in order to provide directions for future research. To this end, this article aims to investigate the main research areas related to supply chain digitalization through a literature review based on keyword analysis. Following the framework proposed by Fadlalla and Amani [5], three main groups of topics were identified: core, trendy, and emerging. Investigating the main ones allowed us to understand which are the fundamental concepts on which the research related to supply chain digitalization is developed. Studying, instead, the trendy and emerging ones allows us to understand in which direction the scientific research on this topic is heading. The remainder of the paper is structured as follows. In the next section the methodology followed is presented, after which the results are discussed by dedicating a paragraph to each of the aforementioned groups of topics, i.e. core, trendy and emerging.

2. Methodology

The methodology used to conduct the study is keywords analysis, according to the model proposed by Fadlalla and Amani [5]. Keywords encode the essence of a research from the researcher's point of view. This analysis has a twofold objective: to identify, investigate and discuss the main research areas related to supply chain digitalization and to classify the major research topics according to their relevance to the scientific community, using a framework that makes the complex relationships between research concepts in these areas more understandable. To achieve this goal, they suggest classifying keywords by crossing two parameters: dominance and persistence. The former refers to the number of times a concept is used as a keyword over time and can be measured in absolute terms as the number of articles that used the concept as a keyword or in relative terms as the percentage of articles in which the given concept was used as a keyword, regardless of time dimension; while the latter refers to the continuity of a given concept over time, and can be measured, in absolute terms, as the number of years that the concept was used as a keyword, or in relative terms as the percentage of years, out of the total number of years covered by the research, that the concept was used as a keyword. The average dominance and persistence values of the sample serve as the threshold for determining high or low dominance and persistence values. As it is shown in Figure 1, the resulting quadrants refer to (1) core topics, with high persistence and dominance, (2) trendy topics, with high dominance and low persistence, (3) intermittent topics, with low dominance and high persistence, and (4) emerging or phantom topics, with low dominance and persistence. To conduct this analysis, a search on the Scopus database was conducted using the following query: (TITLE-ABS-KEY (“digitalization”) OR TITLE-ABS-KEY (“digitization”) AND TITLE-ABS-KEY ("supply chain")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "BUSI")). In order to exclude irrelevant contributions, we narrowed the field to include only articles and conference papers belonging to the subject area Business, Management and Accounting defined by Scopus, published in English. The search returned 244 results, 10 of which were discarded after reading the title and abstract due to the misalignment with the theme of supply chain digitalization. Then we excluded articles without authors' keywords, obtaining a sample of 220 contributions, used for keywords analysis. In the next section the core, trendy and emerging concepts are discussed. We have left out the discussion of phantom and intermittent ones as they are of little interest to identify promising new avenues of future research.

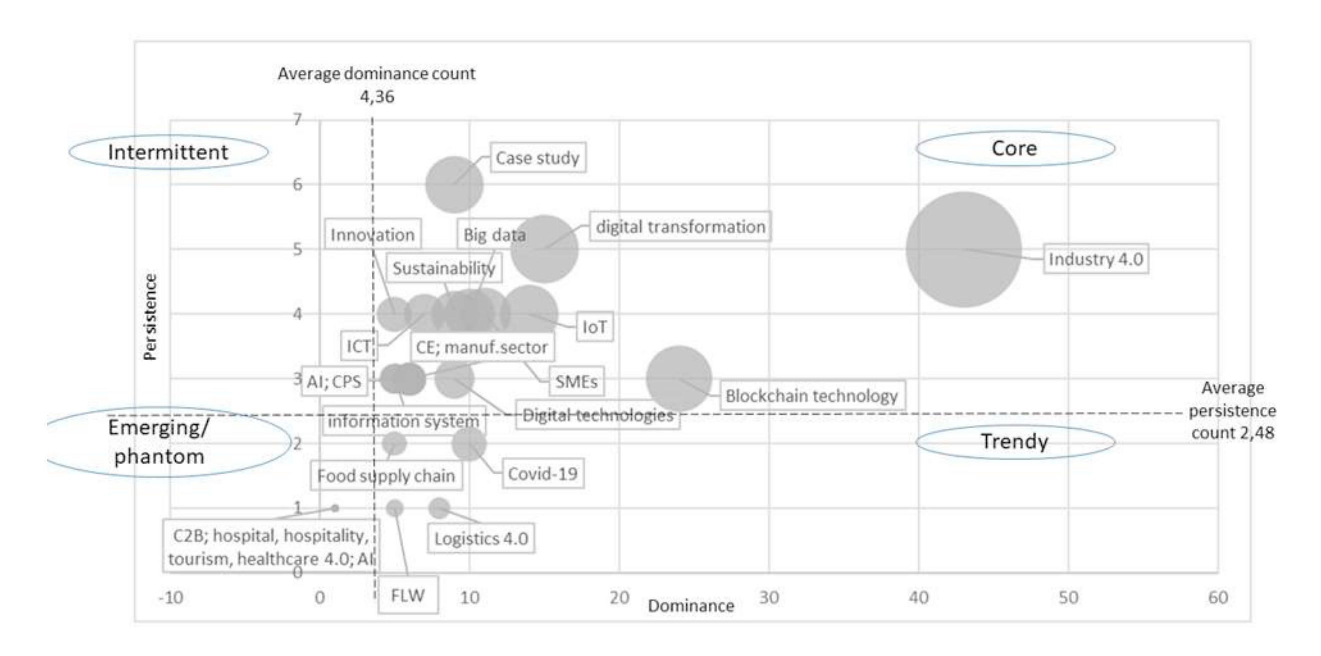


Fig. 1. Persistence versus dominance of the keywords. Framework adapted from [5].

3. Discussion

3.1. Core keywords

As for the core concepts, in addition to the keywords "supply chain" and "digitalization" (excluded from the analysis not to distort the results due to their high frequency and persistence values) they include: artificial intelligence (AI), big data, case study, circular economy, cyber-physical systems, Industry 4.0, information systems, innovation, Internet of Things (IoT), manufacturing sector, SMEs, sustainability, blockchain technology, digital technologies, digital transformation, ICT. Some of them describe very general concepts, therefore, they are likely to be mentioned with a higher frequency by researchers.

3.1.1 Digital technologies

A number of digital technologies are involved in the supply chain digitalization process, and they appear as core keywords in the sample of articles analyzed. In fact, due to the application of these technologies, it is possible to transform a traditional supply chain into a digital one. Among the main ones we distinguish: Internet of Things (IoT), Advanced analytics – involving techniques as Artificial Intelligence (AI) or Machine Learning (ML) –, Augmented reality (AR) and Virtual reality (VR), Blockchain technology, robots, 3D printing and drones [6]. AI is defined as the ability of machines to communicate and take on behaviors peculiar to humans; as a result, this technology is particularly suited to solving problems that require a high degree of accuracy and speed [7]. Supply chain management is one of the fields that benefits most from the use of AI [8]. Toorajipour et al. [9], after conducting a literature review, stated that most of the artificial intelligence techniques are applied in the field of manufacturing. The most widely used technique is Artificial Neural Network (ANN) which belongs to the machine learning field, as ML is the branch of artificial intelligence that concerns the study, construction and implementation of algorithms. Specifically, ANN allows identifying patterns from a huge amount of data. It is mainly used in demand forecasting, pricing, supplier selection and consumption forecasting.

Since information technology is considered as one of the main enablers of effective supply chain management, the Internet of Things (IoT), being one of its most recent developments, represents a fundamental concept in supply chain

digitalization. According to Ben-Daya et al. [10] "Internet of Things is a network of physical objects that are digitally connected to sense, monitor and interact within a company and between the company and its supply chain enabling agility, visibility, tracking and information sharing to facilitate timely planning, control and coordination of the supply chain processes". The Internet of Things is capable of influencing supply chain performance in several ways. Gupta et al. [11] identify four main ones: the IoT enables improved supply chain reliability through real-time data, information sharing and object visibility, helps reduce operational costs incurred in supply chain operation, enables more efficient resource management by tracking real-time data exchange, and increases supply chain agility by facilitating information flow.

Machine Learning techniques represent a significant digitalization trend. The supply chain environment is particularly suited to the use of these techniques because it is characterized by a large amount of data that can be read and processed in order to automate and simplify processes as well as reduce costs and make predictions for the future. Although Machine Learning has not easily caught on in all fields, in the supply chain one it has already been widely used for several years, which is why the term Machine Learning appears among the core keywords [12].

One of the most disruptive technologies within Industry 4.0 is the blockchain one. Among the many benefits that blockchain technology brings to the supply chain, the ability to provide transparency and efficient data sharing among supply chain actors and the ability to minimize risks and uncertainty were identified [13]. In particular, they allow to track products throughout the supply chain preventing the risk of fraud. The presence of counterfeit products on the market is an issue that affects several industries, such as food or fashion, consequently, thanks to blockchain to support transactions, customers can verify the origin of ingredients or raw materials and follow the entire path of realization of the finished product ([14][15]).

3.1.2 SMEs and manufacturing sector

Among the core concepts we can find the manufacturing sector keyword, motivated by the fact that it is a target for supply chain digitalization ([16]). Over the past few years, companies operating in this sector have equipped themselves with powerful and effective tools for demand planning and logistics management while the monitoring of the performance all along the supply chain has received less attention. Above all, many companies lack a systematic approach to supply chain management, i.e. a full understanding of the capacity, productivity, efficiency and quality of machines along the supply chain through the ability to analyse data at the machine/part/batch level [17]. Adopting such a systemic approach allows to benchmark, balance loads, plan production capacity, and implement full production traceability. Indeed, proper supply chain management is one of the practices supporting the transition of manufacturing companies towards Smart Manufacturing, understood as a commitment to achieve higher levels of intelligence and optimisation within factories and along the production value chain. The goal is to achieve optimal process integration, reduced inventory, better products and increased customer satisfaction [18].

Despite the fact that digital transformation has become a prerequisite for companies wishing to remain competitive in the market, many firms struggle to apply and embed technology in their processes. This happens mainly in smaller companies, which is why the keyword Small Medium Enterprise (SME) appears among the main concepts. Digitalization means adapting all business processes to the requirements of the digital age, where speed of execution and efficiency play crucial roles. This need is even more urgent for small and medium enterprises that have to move in an increasingly competitive and ever-changing market. They have access to fewer resources than large companies and multinationals, so they need to be managed more carefully and consciously. One of the main reasons holding back SMEs from implementing digital technologies is the fact that digitalization projects mostly consist of personnel costs and upfront payments, while the share spent on tangible investments is relatively small. This does not allow to offer tangible assets as collateral and consequently it is more difficult to find external investors willing to finance such projects. Moreover, several studies have highlighted the difficulty of accessing bank loans to finance digitalization projects compared to financing investments in tangible assets [19].

3.1.3 Sustainability and circular economy

Digital transformation and sustainability, whether environmental, economic or social [20], are two sides of the same coin. In fact, digitalization allows to efficiently implement a series of actions with a view to sustainability, such

as optimising the use of resources and machinery, choosing greener components and materials and designing products according to the principles of the circular economy, minimising waste and limiting the use of new resources. In addition, digital technologies allow to monitor raw materials and production facilities in order to significantly improve performance and consumption, reduce waste and cut CO^2 emissions [20]. Kumar et al. [22] state that adopting Industry 4.0 technologies, such as cyber-physical systems, IoT, big data, etc., would allow the product to be constantly monitored, providing relevant information throughout its whole life cycle. Ghobakhloo [23] points out that the implementation of digital technologies can foster the implementation of circular economy models based on closing material and resource loops, such as recycling and remanufacturing. In fact, remanufacturing is a virtuous example of the application of technologies also for the purpose of greater efficiency. Some scholars consider remanufacturing as the most advanced paradigm of the circular economy as it is based on the reuse of products and components in such a way as to recover up to 100% of their capacity to perform their function [24] [25]. The adoption of digital technologies to stimulate the shift to a more sustainable business model is hindered by several factors. The main one is the lack of human and technological resources due to the difficulty in finding the necessary financial resources to invest in digitalization. In addition, management's unwillingness to adopt sustainable practices along the supply chain is a further barrier [26].

3.2. Trendy keywords

Trendy topics are those that seem to be very promising for researchers. In our analysis food supply chain, food loss and waste (FLW), Covid-19 and Logistics 4.0 appear as the hot research themes related to the main issue of supply chain digitalization.

3.2.1 Food supply chain digitalization

In the last decades, the world food industry has undergone major changes in terms of food supply and demand, agricultural production techniques, population growth and consumption patterns. It is expected that these changes will become more pronounced in the years to come, seeing an increase in population to feed, constantly changing environmental conditions, and new consumption needs to be met [27]. The food supply chain represents the path that a food product takes from "farm to fork", that is, from raw materials to the food product ready for consumption. For this reason, this industry involves a wide range of processes and operations around the world. In addition, there is a large number of different players contributing to the value chain: farmers, feed and seed producers, breeders, processing industry, transporters and distributors, wholesale and retail traders, and the final consumer [28]. As is the case in many other industries, technology plays a key role in the agri-food one by enabling more efficient use of natural resources and ensuring safe and affordable food for the world's growing population. Thanks to the entry of technological innovation in the agri-food industry, in fact, it is possible to digitalize the entire supply chain, exploiting the data generated and monitoring each process: cultivation, production, suppliers, storage, sales. To do this, the agri-food industry is influenced by the technologies, strategies and methodologies proposed by Industry 4.0 in the manufacturing sector, which is why we similarly speak of Agri-food 4.0 [29].

As previously mentioned, the agri-food value chain consists of a plurality of different actors. It is interesting to analyze the main differences in the adoption of digital technologies by the main actors involved in the "from farm to fork" process: farmers and breeders, companies operating in the food transformation industry and retailers.

Regarding the farming sector, Salemink et al. [30] state that digital transformation is necessary to address the backwardness of this sector. Agricultural production has characteristics such that it could greatly benefit from the digitalization process. First, agriculture is strongly influenced by factors such as weather, climate, soil, or pests [31]. Applying digital technologies to this sector allows to optimize both the time scheduling of farm operations, and the use of the resources employed, such as labor force, or water to irrigate the crops. In particular, modern farming technologies, based on robots, big data, and the Internet of Things can be used to improve current farming techniques, to make decisions to improve the quality and quantity of agricultural production, and to minimize risks and waste [32]. Digitalization supports the decision-making process of farmers, allowing them to implement tailored solutions for each individual field, such as dosing fertilizer and water correctly, selecting the right crop variety, or recognizing the stress level of crops.

Companies involved in processing and transforming raw materials to make the finished food product have as their main constraint that of ensuring product quality and safety. To this end, digital technologies are able to provide for this need by ensuring complete traceability thanks to blockchain technologies. IoT devices make it possible to acquire information along the entire supply chain, so as to monitor the status of raw materials to prevent their deterioration during the different stages of processing. This makes it possible to guarantee hygiene and health standards at all times, ensuring food safety. In addition, digital technologies make it possible to automate processes that would otherwise require constant operator supervision ([31] [33]).

Retailers benefit from digitalization as it allows them to certify the entire food supply chain from start to finish. Among the digital technologies that best suit this purpose, the most suitable is the blockchain one as it allows certifying the history of the product, attributing an added value both for customers, who increasingly demand more transparency, and for the retailers themselves, who would be sure of the quality of the products purchased from their suppliers [34].

Finally, end consumers are also interested in the adoption of digital technologies to improve their user experience. According to the EIT Food Trust report [35], compiled by interviewing over 20,000 consumers from 18 European countries, consumers are demanding greater supply chain transparency throughout the entire process from farm to fork. In addition, the demand for more natural products with more accurate label information has increased in recent decades to raise awareness of product content. Therefore, the use of digital traceability technologies to increase transparency exactly meets the demands of consumers and increases their confidence in the entire production process [36]).

3.2.2 Food loss and waste

Food waste occurs at different points in the agri-food supply chain: at the agricultural, livestock and fishing production stage, at the industrial processing and distribution stage, and at all stages linked to the behaviour of end consumers and different consumption channels. The management of food loss and food waste (FLW) has a double negative impact on the environment: on the one hand there is the consumption of the resources needed to produce it (land, energy, water, human labour and technical means); on the other hand, there is the consumption of the resources needed to destroy or manage it. For this reason, the issue of FLW is a hot topic to be addressed. The adoption of digital technologies along the entire supply chain makes it possible to minimise the risk of FLW [37]. Ostojić et al. [38] state that IoT is a valuable ally since it allows data to be collected throughout the food product lifecycle, from agricultural production to final consumption. These data are collected via sensor networks and give information about temperature, humidity, pesticide use or the logistics transport situation. Cattaneo et al. [39], on the other hand, underline the relevance of blockchain technology to ensure traceability along the entire supply chain. In this way, it is possible to prevent food contamination or issues that make the food no longer edible, thus reducing waste and loss.

3.2.3 The impact of Covid-19

The COVID-19 outbreak in the early 2020 significantly impacted supply chains, accelerating the trend for companies to digitalize and standardize processes to make the exchange of data and information throughout the supply chain more streamlined and efficient [40]. It is interesting to distinguish the adoption of digital technologies during and following the emergency. In the former case, digitalization supported companies in dealing with supply chain disruption, while in the latter case it facilitated business recovery. Nandi et al. [41] argue that the medical emergency helped highlight the importance of supply chain resilience in dealing with unprecedented events. Specifically, the authors state that the application of circular economy principles in order to make the supply chain sustainable are able to contribute positively to the cause. During the Covid-19 outbreak, implementing circular economy practices meant closing resource loops, mitigating the risk of shortages of raw material supplies. Digital technologies play a key role in supporting the implementation of circular practices along the supply chain. Specifically, blockchain technology is particularly well suited to promote supply chain resilience by ensuring timely information and transparency. Being aware of the location and status of resources along the supply chain allows them to be managed more efficiently, limiting waste and enabling the reuse of materials. Herold et al. [40], on the other hand, focused on the role of Logistics Service Providers (LSPs) in supply chain management during the Covid-19 pandemic, emphasizing that building resilience within the supply chain is vital to effectively deal with an unexpected event. In order to foster the

development of resilience, LSPs have implemented digital technologies that can effectively manage and leverage the data generated along the supply chain. Digital technologies, in addition to aiding in supply chain management during the health emergency, have also aided in the resumption of operations in a number of areas. In the agricultural supply chain, for example, Quayson et al. [42] show how digitalization has improved access to services by ensuring the market inclusion of smallholder famers, who hardly accesses the market to sell their products during the health emergency. Blockchain technology has played a key role by allowing buyers to be connected directly to smallholders, without going through numerous intermediaries. Sharma et al. **Errore. L'origine riferimento non è stata trovata.** investigated retail supply chains to understand what strategies companies can adopt to mitigate the long-term effects of pandemic disruption. The authors argue that digital retail supply chains represent the most appropriate business strategies to ensure supply chain sustainability in a post-pandemic horizon.

3.2.4 Logistics 4.0

In recent years, the concept of Industry 4.0 has been joined by that of Logistics 4.0. The spread of digital technologies, which are already revolutionizing every industrial sector, inevitably has consequences on logistics as well. Although there is no univocal definition of logistics 4.0 [44], it can be defined as the planning, through the use of enabling technologies, of the storage flow of raw materials, semi-finished and finished products in order to meet customer needs [45]. The changes introduced by logistics 4.0 are developed along three axes: automation, connection and decision-making. The first one concerns the combination of activities performed automatically and manually. The second axis, on the other hand, concerns the objects and equipment used, which, in logistics 4.0, have the ability to collect data and transmit it through their own connections. The last axis concerns the data itself, whose decentralized collection becomes essential to support the decision-making process. Enabling technologies include RFID, which is used for resource planning, warehouse management, transportation management, and information security [46]. Combined with the Internet of Things, RFID can be used to collect data, track and trace throughout the whole supply chain [46].

3.3. Emerging keywords

From a more in-depth analysis of the keywords results several concepts that highlight a low level of both dominance (appear with a very low frequency) and persistence (they appear in recent years and for a limited number of years). Among these, following a more detailed analysis of the sources, only a few topics have been extrapolated as "emerging": Tourism 4.0 (technology-based transformations towards highly interconnected and digital systems in the tourism industry); Business-to-business-to-consumer, also called C2B or C2C, business models (emerging models of consumer involvement in supply networks and in business operations); healthcare sector (innovation in supply chain management to deal with the complexity of processes in this sector in order to achieve greater efficiency and effectiveness, also to face the challenges posed by Covid 19).

The use of digital technologies is one of the major trends concerning the hospitality industry in recent years, which is why the digitization of the supply chain in this industry is one of the emerging topics derived from this review. In particular, in the literature we have started to talk about tourism 4.0, defined by Peceny et al. [47] as a new paradigm capable of bringing innovation to this sector through the use of the enabling technologies of Industry 4.0 (IoT, AI, big data, blockchain, etc.). big data, in particular, represents an important tool as it allows to collect real-time information about tourists' movements, preferences or purchasing habits. These data are collected from different sources, such as social media or websites visited by tourists. The advantage of these data is their ability to reliably represent the population since they are not collected from a selected sample of tourists. That is why they are widely used for the implementation of forecasting models [48].

As far as the B2B2C business model emerging theme is concerned, it derives from the fact that the role of consumers in supply chains has evolved, supported by the evolution of technologies and the digitalization boom. In recent years, in fact, the individual consumer is no longer just the buyer of the finished product that puts money into the system, but his role has evolved. Thanks to the support of digital platforms, they are able to intervene in different stages of the supply chain, not only in the last one, inputting supplies in the same way as any business company [49]. The involvement of this type of actor in the supply chain has given rise to the emergence of new business models

called consumer-to-business. Aspara et al. [49] point out that the nomenclature of such models is not unambiguous and sometimes scholars refer to them as C2C or B2B2C, although they address to the same concept.

The last main issue arisen from emerging keywords analysis concerns the healthcare sector. Digitalization initiatives in the healthcare supply chain can bring about substantial benefits for this industry. High investments, technical and organizational obstacles/barriers slow down the adoption of digitalization, resulting in a less evolved and digitalized supply chain if compared to that of the other industries. Erratic and disconnected digitalization already deployed in this sector makes it difficult to maximize the potential of these initiatives. For this reason, an adequate cost/benefit valuation and a proper planning of initiatives are necessary before proceeding with the adoption of new technological and organizational solutions [50]. Despite these assumptions, there are several initiatives being undertaken to encourage the effective digitalization of the healthcare supply chain. In particular, two areas are most affected by digital innovation processes: order management and digitalization/automation of pharmaceutical supply chain [51]. Due to the high complexity and riskiness of hospital processes, most of these initiatives have fallen short on results, frustrating managers' efforts. It is therefore essential to formulate guidelines to help managers, authorities, and governments in prioritizing interventions towards the digital transition [52].

4. Conclusion, limitations and future research directions

The increasing pervasiveness of new digital technologies as part of Industry 4.0 has enabled the supply chain to be managed more effectively and efficiently. We talk about digitalization of the supply chain and this trend refers to the evolution towards a smarter model that involves digital technologies such as Blockchain, IoT, Artificial Intelligence, etc. These technologies increase and enhance the ability to optimize planning, sourcing and procurement strategies. Since this topic is of relevant interest for the scientific community, this paper aims help to investigate the main discussion themes related to supply chain digitalization. To this end, a literature review has been conducted using the keywords analysis methodology proposed by Fadlalla and Amani [5]. Following a careful selection of the articles to be analyzed, the proposed framework is based on the dominance and persistence characteristics of keywords identified by the authors, , so that they could be defined as core, trendy, emerging/phantom or intermittent. More relevance has been given to the discussion of core, trendy and emerging, leaving out the intermittent or phantom concepts as not particularly helpful to identify promising lines of future research. As a result, among the core keywords we find the basic concepts of digitalization and Industry 4.0, as well as the industrial sector in which the digitalization of the supply chain is mostly applied (i.e. the manufacturing sector) and the concepts of sustainability and circular economy. The trendy keywords, on the other hand, refer to concepts on which the scientific debate is particularly heated. From our analysis it emerged that the agri-food industry is the one on which researchers' attention is most focused along with the impact of Covid-19. Finally, the emerging themes can be traced back to three main strands of research: supply chain digitalization in the hospitality sector, supply chain digitalization in the healthcare sector and the emergence of new business models enabled by digital technologies.

The main limitation of this research is that it only focused on paper published in scholarly journals included in Scopus database and did not include other sources (i.e. books, proceedings, etc.). The search criteria were based on keyword proposed by the author, leaving out of the analysis all those scientific contributions characterized by similar keywords but not directly included in those considered.

It is possible to identify some directions for future research, especially stemming from trendy and emerging concepts. From the literature study it emerged that one of the main barriers to supply chain digitalization is the high cost of the necessary investments. In particular for SMEs it is not easy to access funding to implement digital technologies. The agri-food sector is particularly affected by this problem, as it is composed of a number of different actors, including smallholder farmers. An interesting line of future research concerns the study and proposal of policies to support digital innovation in the agri-food sector in order to facilitate the digital traceability of products throughout the supply chain, ensuring high quality standards. Always considering the agri-food sector, our research showed that the topic of food loss and waste is very much discussed, representing one of the hottest topics. Although the interest is growing, research on digital technologies in conjunction with FLW is still at an embryonic stage, thus opening space for future investigations on the role of digitalization in FLW prevention. Among the trendy concepts, considerable emphasis is placed on the impact of Covid-19. Despite being a recent topic, the rapid spread of the virus globally has

caused this concept to quickly become popular. Of particular interest is the implication that digitalization can bring to pandemic management in the healthcare sector, which is among the emerging keywords. The ongoing healthcare emergency has highlighted the need for a more interconnected healthcare service, so as to ensure interdisciplinarity among all stakeholders. The digitalization of the healthcare supply chain is an important tool for transformation, consequently it is important that future research is oriented towards the digitalization of its processes. Indeed, the benefit is not only limited to a more efficient management of the covid-19 pandemic, but digitalization allows the hospital system to address potential future unprecedented events more readily. Another sector particularly impacted by the Covid-19 outbreak is the hospitality industry, so there is a need to explore how this sector can equip itself to effectively manage the current crisis.

Future research is needed to enlighten the evolution over time of the classification of the results detected using this framework. and to improve the significance of the results deriving from the application of the framework.

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